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EXAMINER	
KRAIG, WILLIAM F	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/799,961	HOFFMAN ET AL.	
	Examiner	Art Unit	
	William Kraig	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 March 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-18 and 20-56* is/are pending in the application.

4a) Of the above claim(s) *21-36 and 45-47* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-18,20,37-44 and 48-56* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: "Transistor with Multiple Component Oxide Channel".

Claim Objections

2. The objections to claims 1, 18, 37 and 48 are withdrawn in view of Applicant's amendments to the claims dated 3/9/2007.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-20, 37-44 and 48-57 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claims contain references to a formula of the form $A_xB_xO_x$, and then further claim wherein "each x is independently a non-zero number" and further specific ratios of the variable x. However, as it is known in the art, a formula of the form $A_xB_xO_x$ inherently possesses a ratio of the values of x (1:1), and the values of x cannot, by their very nature be considered to be independent, nor can they be considered to have a

ratio other than 1:1. The Examiner will examine the claims with the assumption that each value of x can be different, but suggests a change to a formula such as $A_xB_yO_z$, etc, for clarity.

4. Claims 2, 5, 7, 9, 11, 13, 15, 17, 50, 52, 54 and 56 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claims contain references to formulae of the type $A_xB_xO_x$, wherein A and B are ostensibly elements from a given group. Therefore, in view of the fact that A and B are not numeric values, it is unclear what is meant by "a ratio of A:B, wherein A, and B, are each in a range of about .05 to about .95". The Examiner will examine the claims with the assumption that the ratio refers to the ratio of the values of x for each element in the given formula, which, as discussed above will be viewed as separately independent.

5. The Examiner's rejection of claim 18 under 35 U.S.C. 112, second paragraph, is withdrawn in view of Applicant's amendments to the claims dated 3/9/2007.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 2, 4, 5, 18, 20, 37 and 41-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada et al. (Japan Patent # JP405251705A) in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) with evidence provided by Chen et al. (U.S. Patent Publication # 2005/0037237).

Regarding claim 1, Fig. 4 of Hamada et al. discloses a semiconductor device, comprising:

a drain electrode (10);

a source electrode (11);

a channel (8) contacting the drain electrode (10) and the source electrode (11), wherein the channel includes one or more compounds of the formula $A_xB_xO_x$, wherein each A is selected from the group of Ga, In, each B is selected from the group of Ge, Sn, Pb, each O is atomic oxygen (the material comprising 8 is disclosed to be ITO (InSnO)), each x is independently a non-zero number (The Abstract of Chen et al. teaches that ITO consists of In_2O_3 and Sn_2O_5 at 80 and 20 molecular percent respectively, or $In_8Sn_2O_{17}$ total); and

a gate dielectric (3) positioned between a gate electrode (9) and the channel (8).

Hamada et al., however, fails to disclose that the ITO forming the channel region includes one of an amorphous form and a mixed-phase crystalline form.

Narushima et al. teaches that it is desirable to form use amorphous ITO (a-ITO) as a semiconductor material (Narushima et al., Col. 1).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the amorphous ITO of Narushima et al. into the device of Hamada et al. The ordinary artisan would have been motivated to modify Hamada et al. in the above manner for the purpose of taking advantage of the high electron mobility associated with the amorphous ITO and the ability of amorphous ITO to be deposited on plastic, flexible substrates (Narushima et al., Col. 1).

Regarding claim 4, Hamada et al. and Narushima et al. disclose the semiconductor device of claim 1 (with evidence provided by Chen et al.), wherein the one or more compounds of the formula $A_xB_xO_x$ is indium-tin oxide.

Regarding claims 2 and 5, Hamada et al. and Narushima et al. disclose the semiconductor device of claims 1 and 4 (with evidence provided by Chen et al.), wherein the one or more compounds of the formula $A_xB_xO_x$ includes a ratio of A:B, wherein each of A and B are in a range of about .05 to .95 (Chen et al. discloses ITO having a ratio of .8:.2, which satisfies the limitations of this claim).

Regarding claim 18, Hamada et al. and Narushima et al. (with evidence provided by Chen et al.) disclose a semiconductor device, comprising:

a drain electrode (10);

a source electrode (11);

means for controlling current flow (8) to electrically coupled to the drain electrode (10) and the source electrode (11), wherein the means for controlling current flow (8) includes one or more compounds of the formula $A_xB_xO_x$, wherein each A is selected from the group of Ga, In, each B is selected from the group of Ge, Sn, Pb, each O is atomic oxygen (the material comprising 8 is disclosed to be ITO (InSnO)), each x is independently a non-zero number (The Abstract of Chen et al. teaches that ITO consists of In_2O_3 and Sn_2O_5 at 80 and 20 molecular percent respectively, or $In_8Sn_2O_{17}$ total) wherein the channel includes an amorphous form (Narushima et al., Col. 1); and

a gate electrode (9) separated from the channel (8) by a gate dielectric (3).

Regarding claim 20, Hamada et al. and Narushima et al. (with evidence provided by Chen et al.) disclose the semiconductor device of claim 18, wherein the source (11), drain (10), and gate (9) electrodes include a substantially transparent material (ITO).

Regarding claim 37, Hamada et al. and Narushima et al. (with evidence provided by Chen et al.) disclose a semiconductor device formed by the steps, comprising:

providing a drain electrode (10);

providing a source electrode (11);

depositing a channel (8) including a composition (composition including one or more precursor compounds that include A_x and one or more compounds

that include B_x, wherein each A is selected from the group of Ga, In, each B is selected from the group Ge, Sn, Pb) to form a multicomponent oxide (ITO), (each x is independently a non-zero number (The Abstract of Chen et al. teaches that ITO consists of In_2O_3 and Sn_2O_5 at 80 and 20 molecular percent respectively, or $In_8Sn_2O_{17}$ total), wherein the channel includes an amorphous form (Narushima et al., Col. 1)) from the composition to electrically couple the drain electrode (10) and the source electrode (11) (see Fig. 4 of Hamada et al.);

providing a gate electrode (9); and

providing a gate dielectric (3) positioned between the gate electrode (9) and the channel (8).

Hamada et al. and Narushima et al., however, fail to disclose the step of providing a precursor composition.

The claim to providing a precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a precursor composition is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al. and Narushima et al.

Regarding claim 41, the claims to a method wherein depositing the channel includes vaporizing the precursor composition to form a vaporized precursor composition, and depositing the vaporized precursor composition using a physical vapor

deposition technique including one or more of dc reactive sputtering, rf sputtering, magnetron sputtering, ion beam sputtering are product by process limitations and are given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). This particular process of vaporizing the precursor composition to form a vaporized precursor composition, and depositing the vaporized precursor composition using a physical vapor deposition technique including one or more of dc reactive sputtering, rf sputtering, magnetron sputtering, ion beam sputtering is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al. and Narushima et al.

Regarding claim 42, Hamada et al. and Narushima et al. disclose the semiconductor device of claim 37, wherein providing the source (11), the drain (10), and the gate (9) electrodes includes providing a substantially transparent form of the source, the drain, and the gate electrodes (ITO).

Regarding claim 43, the claim to providing a liquid form of the precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a liquid form of the precursor composition is therefore irrelevant

given that the final product of the claim is anticipated by Hamada et al. and Narushima et al.

Regarding claim 44, the claim to an ink-jet deposition technique for forming the channel is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular ink-jet deposition technique for forming the channel is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al. and Narushima et al.

7. Claims 6, 7, 8, 9 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada et al. (Japan Patent # JP405251705A) in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) further in view of Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) with evidence provided by Chen et al. (U.S. Patent Publication # 2005/0037237).

Regarding claim 6, Hamada et al. and Narushima et al. (with evidence provided by Chen et al.) disclose the semiconductor device of claim 1, but fails to disclose the specifics claimed in claim 6.

Phillips et al. teaches the use of $GaIn_{1-x}Sn_xO_3$ as a replacement for a layer of ITO.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the $GaIn_{1-x}Sn_xO_3$ layer of Phillips et al. into the device of Hamada et al. and Narushima et al. The ordinary artisan would have been motivated to modify Hamada et al. and Narushima et al. in the above manner for the purpose of further lowering the conductivity of the transparent oxide semiconductor channel region of Hamada et al. and Narushima et al. and increasing the transparency of the transparent oxide semiconductor channel region. (Hamada et al., Paragraph 25) (Phillips et al., Page 117, Final Paragraph)

Regarding claim 8, Hamada et al., Narushima et al. and Phillips et al. disclose the semiconductor device of claim 1 (with evidence provided by Chen et al.), wherein the one or more compounds of the formula $A_xB_xO_x$ is gallium-indium-tin oxide (Phillips et al., Page 115, Col. 2, Top Paragraph).

Regarding claims 7 and 9, Hamada et al., Narushima et al. and Phillips et al. disclose disclose the semiconductor device of claims 6 and 8 (with evidence provided by Chen et al.), wherein the one or more compounds of the formula $A_xB_xC_xO_x$ includes a ratio of A:B:C, wherein each of A, B and C are in a range of about .025 to .95 (Phillips et al. discloses $GaIn_{1-x}Sn_xO_3$ (0<=x<=20), which satisfies the limitations of this claim).

Regarding claim 38, Hamada et al., Narushima et al. and Phillips et al. disclose the semiconductor device of claim 37, but fails to disclose the one or more precursor

compounds including one or more precursor components that include C_x, wherein each C is selected from the group of Ga, In, Ge, Sn, Pb, each x is independently a non-zero number, and wherein each of A, B, and C are different. (See rejection of claim 6 above, wherein the combination of Hamada et al., Narushima et al. and Phillips et al. is shown to disclose GaSnInO).

The claim to providing a precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a precursor composition is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al., Narushima et al. and Phillips et al. (See rejection of claim 6 above, wherein the combination of Hamada et al., Narushima et al. and Phillips et al. is shown to disclose GaSnInO).

8. Claims 10-13 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada et al. (Japan Patent # JP405251705A) in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) further in view of Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) further in view of Minami ("Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4),

Jul/Aug 1999) with evidence provided by Chen et al. (U.S. Patent Publication # 2005/0037237).

Regarding claim 10, Hamada et al., Narushima et al. and Phillips et al. disclose the semiconductor device of claim 6 (with evidence provided by Chen et al.), but fail to specifically disclose the limitations added by claim 10.

Phillips et al., however, does disclose that both GaGeInO and GaInSnO are transparent conducting oxides with desirable properties (more transparent then other known TCOs).

Minami teaches that a transparent conducting oxide will always be obtained when combining oxides which are TCO film materials or transparent conductors.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Minami into the devices of Hamada et al., Narushima et al. and Phillips et al. and combine the GaGeInO and GaInSnO of Phillips et al. to form a new multicomponent oxide. The ordinary artisan would have been motivated to modify Hamada et al., Narushima et al. and Phillips et al. in the above manner for the purpose of creating a new multicomponent oxide suitable for use as the channel of a switching device employed for use in a light emitting system because of its specific electrical, optical and chemical properties and its specific bandgap energy and workfunction, which can be controlled by altering the chemical composition (Minami, Conclusion).

The claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233

(CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 12, Hamada, Narushima et al., Phillips et al. and Minami disclose the semiconductor device of claim 1 (with evidence provided by Chen et al.), wherein the one or more compounds of the formula $A_xB_xO_x$ is gallium-indium-germanium-tin oxide (combination of GaInSnO and GaGeInO would result in GaInGeSnO).

Regarding claims 11 and 13, the claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 39, Hamada, Narushima et al., Phillips et al. and Minami disclose the semiconductor device of claim 38, but fails to disclose wherein the one or more precursor compounds includes one or more precursor compounds that include D_x, wherein each D is selected from the group of Ga, In, Ge, Sn, Pb, each x is

independently a non-zero number, and wherein each of A, B, C, and D are different. (See rejection of claim 10 above, wherein the combination of Hamada et al., Narushima et al., Phillips et al. and Minami is shown to disclose GaInGeSnO).

The claim to providing a precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a precursor composition is therefore irrelevant given that the final product of the claim is anticipated by Hamada, Narushima et al., Phillips et al. and Minami (See rejection of claim 10 above, wherein the combination of Hamada, Narushima et al., Phillips et al. and Minami is shown to disclose GaInGeSnO).

9. Claims 14-17 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada et al. (Japan Patent # JP405251705A) in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) further in view of Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) further in view of Minami ("Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4), Jul/Aug 1999), further in view of D ("Transparent Conducting PbO_2 films prepared by activated reactive evaporation", Phys. Rev. B 33,2660 - 2664 (1986)) with evidence provided by Chen et al. (U.S. Patent Publication # 2005/0037237).

Regarding claim 14 and 16, Hamada, Narushima et al., Phillips et al. and Minami disclose the semiconductor device of claims 1 and 10 (with evidence provided by Chen et al.), but fail to disclose the one or more compounds of formula $A_xB_xC_xD_xO_x$ including E_x, to form a compound of the formula $A_xB_xC_xD_xE_xO_x$, wherein each E is selected from the group of Ga, In, Ge, Sn, Pb, each O is atomic oxygen, each x is independently a non-zero number, and wherein each of A, B, C, D, and E are different.

D discloses a transparent conductive oxide semiconductor of PbO_2.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the PbO_2 of D into the device of Hamada, Narushima et al., Phillips et al. and Minami and combine the PbO_2 of D into the GaGeInSnO of Hamada, Narushima et al., Phillips et al. and Minami to form a new multicomponent oxide (GaGeInSnPbO). The ordinary artisan would have been motivated to modify Hamada, Narushima et al., Phillips et al. and Minami in the above manner for the purpose of creating a new multicomponent oxide suitable for use as the channel of a switching device employed for use in a light emitting system because of its specific electrical, optical and chemical properties and its specific bandgap energy and workfunction, which can be controlled by altering the chemical composition (Minami, Conclusion). The ordinary artisan would have expected a reasonable degree of success in this combination because Minami teaches that a transparent conducting oxide will always be obtained when combining oxides which are TCO film materials or transparent conductors.

The claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claims 15 and 17, the claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 40, Hamada, Narushima et al., Phillips et al., Minami and D disclose the semiconductor device of claim 39, wherein the one or more precursor compounds includes one or more precursor compounds that include E_x, wherein each E is selected from the group of Ga, In, Ge, Sn, Pb, each x is independently a non-zero number, and wherein each of A, B, C, D, and E are different (See rejection of claims 14 and 16 above, wherein the combination of Hamada, Narushima et al., Phillips et al., Minami and D is shown to disclose GaInGeSnPbO).

The claim to providing a precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a precursor composition is therefore irrelevant given that the final product of the claim is anticipated by Hamada, Narushima et al., Phillips et al., Minami and D (See rejection of claims 14 and 16 above, wherein the combination of Hamada, Narushima et al., Phillips et al., Minami and D is shown to disclose GaInGeSnPbO).

10. Claims 48-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akimoto (U.S. Patent # 6476788) in view of Hamada et al. (Japan Patent # JP405251705A) in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) with evidence provided by Chen et al. (U.S. Patent Publication # 2005/0037237).

Regarding claim 48, Figs. 1-3 of Akimoto discloses a display device, comprising:

a plurality of pixel devices (Akimoto, Col. 5, Lines 15-21) configured to operate collectively to display images (Akimoto, Col. 5, Lines 48-54), where each of the pixel devices includes a semiconductor device 28 (Akimoto, Col. 5, Lines 15-21) configured to control light emitted by the pixel device (see Fig. 2 of Akimoto), the semiconductor device including:

a channel (300) contacting a drain (4, 5) and a source (2, 3);

a gate electrode (1); and

a gate dielectric (12) positioned between the gate electrode (1) and the channel (300) and configured to permit application of an electric field to the channel (see Fig. 3C of Akimoto).

Akimoto, however, fails to disclose the specifics of the semiconductor device as are claimed.

Hamada et al. teaches a similar semiconductor device wherein a semiconductor device in a display device includes a drain electrode 10, a source electrode 11, a channel (8) contacting the drain electrode (10) and the source electrode (11), wherein the channel includes one or more compounds of the formula $A_xB_xO_x$, wherein each A is selected from the group of Ga, In, each B is selected from the group of Ge, Sn, Pb, each O is atomic oxygen (the material comprising 8 is disclosed to be ITO (InSnO)), each x is independently a non-zero number (The Abstract of Chen et al. teaches that ITO consists of In_2O_3 and Sn_2O_5 at 80 and 20 molecular percent respectively, or $In_8Sn_2O_{17}$ total), a gate electrode 9, and a gate dielectric 3 positioned between the gate electrode 9 and the channel 8 and configured to permit application of an electric field to the channel (see Fig. 4 of Hamada et al.).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the specific properties of the device of Hamada et al. into the device of Akimoto. The ordinary artisan would have been motivated to modify Akimoto in the above manner for the purpose of building a switching device for driving a

photoelectric transducer wherein the properties of said device are not influenced by light (Paragraph 1, Hamada et al.).

Akimoto and Hamada et al., however, fail to disclose that the ITO forming the channel region includes one of an amorphous form and a mixed-phase crystalline form.

Narushima et al. teaches that it is desirable to form use amorphous ITO (a-ITO) as a semiconductor material (Narushima et al., Col. 1).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the amorphous ITO of Narushima et al. into the device of Akimoto and Hamada et al. The ordinary artisan would have been motivated to modify Akimoto and Hamada et al. in the above manner for the purpose of taking advantage of the high electron mobility associated with the amorphous ITO and the ability of amorphous ITO to be deposited on plastic, flexible substrates (Narushima et al., Col. 1).

Regarding claim 49, Akimoto, Hamada and Narushima et al. (with evidence provided by Chen et al.) disclose the display of claim 48, wherein the source (11), drain (10), and gate (6) electrodes include a substantially transparent material (ITO).

Regarding claim 50, Akimoto, Hamada and Narushima et al. (with evidence provided by Chen et al.) disclose the device of claim 48, wherein the one or more compounds of the formula $A_xB_xO_x$ includes a ratio of A:B, wherein each of A and B are in a range of about .05 to .95 (Chen et al. discloses ITO having a ratio of .8:.2, which satisfies the limitations of this claim).

11. Claims 51 and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akimoto (U.S. Patent # 6476788) in view of Hamada et al. (Japan Patent # JP405251705A) in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) further in view of Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) with evidence provided by Chen et al. (U.S. Patent Publication # 2005/0037237).

Regarding claim 51, Akimoto, Hamada and Narushima et al. (with evidence provided by Chen et al.) disclose the display of claim 48.

Phillips et al. teaches the use of $GaIn_{1-x}Sn_xO_3$ as a replacement for a layer of ITO.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the $GaIn_{1-x}Sn_xO_3$ layer of Phillips et al. into the device of Akimoto and Hamada et al.

The ordinary artisan would have been motivated to modify Akimoto, Hamada and Narushima et al. in the above manner for the purpose of further lowering the conductivity of the transparent oxide semiconductor channel region of Akimoto, Hamada and Narushima et al. and increasing the transparency of the transparent oxide semiconductor channel region. (Hamada et al., Paragraph 25) (Phillips et al., Page 115)

Regarding claim 52, Akimoto, Hamada et al., Narushima et al. and Phillips et al. (with evidence provided by Chen et al.), disclose the device of claim 51, wherein the one or more compounds of the formula $A_xB_xC_xO_x$ includes a ratio of A:B:C, wherein each of A, B and C are in a range of about .025 to .95 (Phillips et al. discloses $GaIn_{1-x}Sn_xO_3$ (0<=x<=20), which satisfies the limitations of this claim).

12. Claims 53 and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akimoto (U.S. Patent # 6476788) in view of Hamada et al. (Japan Patent # JP405251705A) in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) further in view of Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) further in view of Minami ("Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4), Jul/Aug 1999) with evidence provided by Chen et al. (U.S. Patent Publication # 2005/0037237).

Regarding claim 53, Akimoto, Hamada et al., Narushima et al. and Phillips et al. disclose the semiconductor device of claim 51 (with evidence provided by Chen et al.), but fail to specifically disclose the limitations added by claim 53.

Phillips et al., however, does disclose that both GaGeInO and GaInSnO are transparent conducting oxides with desirable properties (more transparent then other known TCOs).

Minami teaches that a transparent conducting oxide will always be obtained when combining oxides which are TCO film materials or transparent conductors.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Minami into the devices of Akimoto, Hamada et al., Narushima et al. and Phillips et al. and combine the GaGeInO and GaInSnO of Phillips et al. to form a new multicomponent oxide. The ordinary artisan would have been motivated to modify Akimoto, Hamada et al., Narushima et al. and Phillips et al. in the above manner for the purpose of creating a new multicomponent oxide suitable for use as the channel of a switching device employed for use in a light emitting system because of its specific electrical, optical and chemical properties and its specific bandgap energy and workfunction, which can be controlled by altering the chemical composition (Minami, Conclusion).

The claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 54, the claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the

art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

13. Claims 55 and 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akimoto (U.S. Patent # 6476788) in view of Hamada et al. (Japan Patent # JP405251705A) in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) further in view of Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) further in view of Minami ("Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4), Jul/Aug 1999) further in view of D ("Transparent Conducting PbO_2 films prepared by activated reactive evaporation", Phys. Rev. B 33,2660 - 2664 (1986)) with evidence provided by Chen et al. (U.S. Patent Publication # 2005/0037237).

Regarding claim 55, Akimoto, Hamada, Narushima et al., Phillips and Minami disclose the semiconductor device of claim 53 (with evidence provided by Chen et al.), but fail to disclose the one or more compounds of formula $A_xB_xC_xD_xO_x$ including E_x, to form a compound of the formula $A_xB_xC_xD_xE_xO_x$, wherein each E is selected from the group of Ga, In, Ge, Sn, Pb, each O is atomic oxygen, each x is independently a non-zero number, and wherein each of A, B, C, D, and E are different.

D discloses a transparent conductive oxide semiconductor of PbO_2.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the PbO_2 of D into the device of Akimoto, Hamada, Narushima et al., Phillips and Minami and combine the PbO_2 of D into the GaGeInSnO of Akimoto, Hamada, Narushima et al., Phillips and Minami to form a new multicomponent oxide (GaGeInSnPbO). The ordinary artisan would have been motivated to modify Akimoto, Hamada, Narushima et al., Phillips and Minami in the above manner for the purpose of creating a new multicomponent oxide suitable for use as the channel of a switching device employed for use in a light emitting system because of its specific electrical, optical and chemical properties and its specific bandgap energy and workfunction, which can be controlled by altering the chemical composition (Minami, Conclusion). The ordinary artisan would have expected a reasonable degree of success in this combination because Minami teaches that a transparent conducting oxide will always be obtained when combining oxides which are TCO film materials or transparent conductors.

The claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 56, the claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Response to Arguments

14. Applicant's argument that the current title "Semiconductor Device" is "short and specific" is not found persuasive. While the Examiner does not disagree with the assertion that the title is short, he does disagree with the assertion that the current title is specific. A quick search of United States Patents for "semiconductor device" returns almost 128,000 references, while a quick search of U.S. Patents and Publications returns over 200,000 hits. Referencing M.P.E.P. section 606.01, the Examiner notes that it is stated that "(a) loss in brevity of title will be more than offset by the gain in its informative value in indexing, classifying, searching, etc." Examiner therefore again requests that Applicant modify the title in such a way as to make it more descriptive. If the Applicant does not consider the Examiner's suggestion to be appropriate, the Examiner is open to suggestion.

Applicant's arguments regarding the rejection of claims 1-20, 37-44 and 48- under 35 U.S.C. 112, second paragraph, are not found persuasive. The Examiner again asserts that a formula of the form $A_xB_xO_x$ inherently possesses a ratio of the

values of x (1:1:1), and the values of x cannot, by their very nature be considered to be independent, nor can they be considered to have a ratio other than 1:1:1. Examiner argues that the claim limitation "each x is independently a non-zero number", does not clarify the claim. The limitation in question ("each x is independently a non-zero number") could be interpreted, for instance, to mean that each of the subscript values are determined independently, but still could all be the same value, i.e., the term "independent" is not synonymous with "different".

Applicant's arguments regarding the rejection of claims 2, 5, 7, 9, 11, 13, 15, 17, 50, 52, 54 and 56 under 35 U.S.C. 112, second paragraph, are not found persuasive. The Examiner argues that the limitations "each A is selected from the group of Ga, In, each B is selected from the group of Ge..." and "a ratio of A:B, wherein A, and B, are each in a range of about 0.05 to about 0.95", are unclear as it is unclear whether A and B are elements or numbers.

Applicant's arguments with respect to all claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William Kraig whose telephone number is 571-272-8660. The examiner can normally be reached on Mon-Fri 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

WFK
05/23/2007

JEROME JACKSON
PRIMARY EXAMINER